

ABSTRACT

A fuel processor including a hydrogen generating apparatus, a single vessel heat-integrated multi-stage water-gas shift reactor, a multifunctional heat exchanger, a multiple heat source boiler, and a single vessel water exchanged multi-staged preferential oxidation reactor is integrated with a fuel cell stack. Hydrogen is manufactured by the fuel processing apparatus and is consumed by the fuel cell stack, thereby providing one means of integration. The portion of the hydrogen that is not utilized within the fuel cell stack is subsequently burned in the combustion chamber of the fuel processing apparatus thereby providing a second means of integration. The warm cooling water that exits from the fuel cell stack is used as a heat sink for the exothermic heat of reaction in the preferential oxidation reactor, thereby providing a third means of integration.